OBJECTIVE 25: LABORATORY OPERATIONS

OBJECTIVE

Demonstrate laboratory operations and procedures for measuring and analyzing samples.

INTENT

This objective is derived from NUREG-0654 which provides that OROs should have the capability to perform laboratory analyses of the level of radioactivity of selected radionuclides in air, liquid, and enviromental samples to determine their relationship to protective action guides. (See evaluation criteria in Planning Standards C., H., I., J., M., and N.)

Because of the relatively long half-lives of certain radioactive isotopes, some radioactive materials released during an accident may continue to pose a radiological hazard for months or years. Radioactive releases may pose long term hazards to humans and animals and necessitate laboratory analyses of the following types to evaluate the hazards:

- o hazard from inhalation of radioiodines; and particulate materials
- o external hazard from ground deposition, and
- o an internal hazard due to ingestion of contaminated food, milk products, and drinking water.

Laboratory analyses of radioactive material samples can yield important data for analyzing accident hazards, and for making protective action decisions. During the emergency phase of a radiological incident, iodine cartridge and particulate filter samples secured from the plume pathway emergency planning zone (EPZ) by field teams should be received by the laboratory for analyses. Soil and agricultural product samples taken from the ingestion pathway EPZ should also be received, as well as surface samples, in support of decisions on relocation, re-entry, and return. Demonstration of this objective focuses on the laboratory equipment, staff, and analysis procedures in accordance with ORO plans.

This objective receives samples for analysis from Objective 8, Field Radiological Monitoring - Airborne Radioiodine and Particulate Activity Monitoring, and Objective 24, Post-Emergency Sampling, and data from the analysis of samples from this objective supports Objective 26, Ingestion Exposure Pathway - Dose Projection and Protective Action Decision Making. Technical guidance for this objective is also provided in the FEMA documents FEMA REP-12, Guidance on Offsite Radiation Measurement Systems: Phase 2, The Milk Pathway, and FEMA REP-13, Guidance on Offsite Emergency Radiation Measurement Systems: Phase 3 - Water and Non-Dairy Food Pathway.

DEMONSTRATION CRITERIA

NUREG		CRITERION
C.3., J.11.	**1.**	**The laboratory has the capability to process samples, as required.**

Explanation

The laboratory staff should demonstrate the capability to follow appropriate procedures for receiving samples including logging of information, preventing contamination of the laboratory, preventing build-up of background radiation due to stored samples, preventing cross contamination of samples, preserving samples that may spoil (e.g., milk), and keeping track of sample identity. In addition, the laboratory staff should demonstrate the capability to prepare samples for conducting measurements.

They should also demonstrate the capability to communicate with OROs who are responsible for delivering samples to the laboratory regarding expected time or arrival of samples and the capacity of the laboratory to receive and process samples, as well as to explain the types of samples and analyses the laboratory is capable of processing. They should ensure that the numbers and types of samples delivered do not exceed the laboratory's capabilities for storage and measurement within a suitable time.

Examples of techniques used for preventing contamination of the laboratory include the use of smear samples to check exterior surfaces of sample containers before they enter the laboratory, or putting the sample containers into clean containers (e.g., transparent plastic bags). Examples of methods for reducing cross contamination of samples are the use of clean gloves or tools to handle the samples, the use of clean bags or wrappers for the samples entering the counting system, and the use of plastic liners for reusable gamma counting containers. The use of temporary bench covers and walkway covers to maintain contamination free laboratory surfaces is a commonly used method.

Build-up of background radiation from the accumulation of radioactive samples is usually prevented by storing samples with radiation levels that are detectable by portable survey instruments, as well as samples that have already been analyzed, in a shielded area or at a location outside the laboratory.

Perishable samples are usually kept fresh by refrigeration or by the addition of chemicals (e.g., thiaole or formaldehyde). Sample preparation varies by the type of measurement to be made. Some examples of preparation are weighing, packing into fixed geometry counting containers, evaporating, using chemical reagents, and mixing with scintillator solutions.

Extent of Play

Under this criterion, all activities should be performed as they would be in an actual emergency.

In the event that the laboratory receives a large number of samples, these activities may be performed for a representative number of each type of sample received. An acceptable representative number should be determined by the FEMA Regional Assistance Committee (RAC) Chair. All arrangements necessary to accommodate the scope of exercise play and demonstration of these procedures should be made by the responsible parties with the RAC Chair before the exercise and identified in the extent-of-play agreement.

NUREG		CRITERION
C.3., J.11.	**2.**	**The laboratory is equipped with laboratory-grade analytical instruments suitable for determining radioisotopes present and levels of radioactivity in samples. Trained personnel use this equipment to perform procedures for assessment.**

Explanation

The laboratory staff should demonstrate the capability to assure accuracy and precision of analyses. This usually consists of (1) using sources for equipment calibration that are traceable to the National Institutes of Standards (2) occasionally checking background count rates and count rates of standard sources (3) assuring accurate measurements of weights of samples, and (4) sending portions of some samples to other laboratories for their analysis.

The laboratory(ies) instrument calibrations should be traceable to standards provided by the National Institutes of Standards. The laboratory(ies) should have the capability for analyses of gamma spectra [e.g., high resolution lithium drifted germanium Ge(Li) or high purity germanium detectors and associated spectrometry equipment] and beta measurements on other important fission products, such as strontium isotopes.

Responsible OROs should demonstrate that the laboratory(ies) they use is staffed with qualified personnel experienced in counting room techniques and contamination control. OROs should also provide evidence that the staff at this laboratory(ies) have sufficient knowledge to adequately analyze the types of samples that may be presented as a result of an accidental release from a nuclear power plant.

The laboratory(ies) should have some established procedures to assure the ORO that measurements of radioactivity made by different laboratories are comparable.

Laboratory staff should demonstrate the capability to use a fixed (reproducible) geometry for counting. This method entails placing the samples or sample media in a consistent physical (volumetric) arrangement adapted for the analytical equipment. They should demonstrate the capability for prompt and explicit communication to proper authorities regarding relevant laboratory results on samples, especially those exceeding protective action guides (PAG) or other limits specified in the plan.

A laboratory is usually equipped to measure very low levels of radioactivity. Such analyses require long background counts and long sample counts. However, for decisions on emergency response, it is usually not necessary to detect these very low levels and it is reasonable to decrease the counting time to that which provides sufficient accuracy and precision to detect the levels of concern for protective action decisions. The laboratory staff should be interviewed regarding whether the urgency of getting sample results, the level of accuracy and precision needed, ambient radiation background levels, and the number of samples to be processed have been taken into account in establishing their counting times.

Extent of Play

Under this criterion, all activities should be performed as they would be in an actual emergency. It is desirable, but not essential, that analyses be conducted on samples collected in the exercise by field teams. If necessary, laboratory operations may be demonstrated out-of-sequence with the rest of the exercise. All assigned staff and designated equipment should be involved in the demonstration.

<u>NUREG</u> <u>CRITERION</u>

N.1.a. **3.** **All activities described in the demonstration criteria for this objective are carried out in accordance with the plan, unless deviations are provided for in the extent-of play agreement.**

Explanation

Responsible OROs should demonstrate the capability to follow policies, implement procedures, and utilize equipment and facilities contained in the plans. OROs should demonstrate that they can follow sequences outlined in the various procedures and perform specified activities, as necessary.

Extent of Play

Under this criterion, all activities should be carried out as specified in the plan, unless deviation from the plan is provided for in the extent-of-play agreement.

CLARIFICATION OF TERMS

The following definitions describe the limited meaning of terms in the context of the Exercise Evaluation Methodology and may vary from the full technical definition for all circumstances.

Counting refers to using an instrument to detect individual particles or gamma rays which interact with the detector on the instrument. For example, ambient radiation can be counted, or, alternatively, the radiation emitted by specific samples can be counted.

Fixed (reproducible) geometry refers to a method of measuring levels of radioactivity in samples by using a standard size or volume of samples held at a fixed distance from the measuring instrument.

Half-life refers to the time required for a particular quantity of a radionuclide to reduce the rate at which it emits radiation by one half.

Isotope refers to one of two or more atoms of an element which have the same number of protons in the nucleus but a different number of neutrons. Some isotopes of a particular element may be radioactive while the others are not.

Measuring refers to counting to detect radiation levels or determining other parameters, such as the energy of radiation or physical characteristics of samples, such as the volume of an air sample.

Re-entry refers to temporary entry of individuals into a restricted zone under controlled conditions.

Relocation refers to a protective action, taken in the post-emergency phase, through which individuals not evacuated during the emergency phase are asked to vacate a contaminated area to avoid chronic radiation exposure from deposited radioactive material.